WHAT IS CLAIMED IS:

1. A method for tracking the flow of N materials and their interfaces in a computational domain, the method comprising the steps of:

(a) creating a macrogrid including control volumes on a computational domain in which N materials and their interfaces are to be tracked;

(b) overlaying a microgrid including microgrid cells upon the macrogrid with each of the microgrid cells being coupled to a control volume;

(c) initializing the macrogrid and control volumes with initial and boundary conditions;

(d) assigning a unique identifier to each of the N materials and to the microgrid cells;

(e) calculating volume fractions for the N-materials in the control volumes;

(f) solve equations of motion upon the macrogrid and control volumes utilizing the calculated volume fractions to arrive at local velocity conditions for the control volumes;

(g) advecting the microgrid cells within the microgrid in response to the calculated local velocity conditions in the control volumes such that voids and overlaps of the microgrid cells in the microgrid occur;

(h) reallocating the microgrid cells so that only one material is in each microgrid cell to effectively conserve mass and satisfy local fluid fraction gradient values; and

1   (i)   repeating steps (e)-(h) until a satisfactory number of time steps has

2   occurred to complete the simulation.

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4   2.   The method of claim 1 wherein:

5   the unique identifier numbers are prime numbers.

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7   3.   The method of claim 1 wherein:

8   the unique identifier numbers are generated by an Eulerian quadratic

9   number generator.

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11   4.   The method of claim 2 wherein:

12   modular arithmetic is used to track the fluid materials which are

13   advected into the microgrid cells of the grid.

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15   5.   The method of claim 1 wherein:

16   the number N of materials tracked is at least 3.

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18   6.   The method of claim 1 wherein:

19   the number N of materials tracked is at least 4.

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21   7.   The method of claim 1 wherein:

22   the interfaces between the N materials are tracked by the location of

23   the microgrid cells containing different fluid materials.

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25   8.   A method for tracking cells in a fluid dynamics computation comprising:

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27   assigning unique identifiers to cells located in a grid, the unique

28   identifiers being associated with respective fluid materials;

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30   advecting the cells within a grid in response to local velocity conditions

31   such that some of the cells overlap one another in the grid and voids

32   are created in the grid; and

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2   calculating the presence of overlapping cells and voids in the grid by

3   taking a combination of the unique identifiers of each of the cells

4   located at a particular microgrid location.

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6   9.   The method of claim 8 wherein:

7   the unique identifier numbers are prime numbers.

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9   10.   The method of claim 8 wherein:

10   modular arithmetic is applied to the product of the unique identifiers of

11   overlapping cells to determine which fluid materials are present in the

12   overlapping cells.